Abrupt Climate Change on Titan

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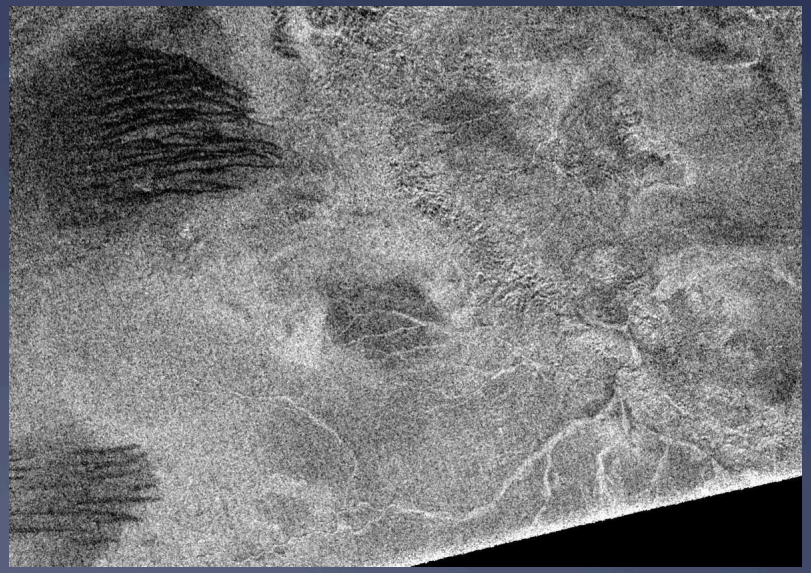
Outline

- Brief survey of Titan
- Motivation
- Model
- Radiation Scheme
- Effects of Methane on Equilibrium Temperature
- Future adjustments of Model

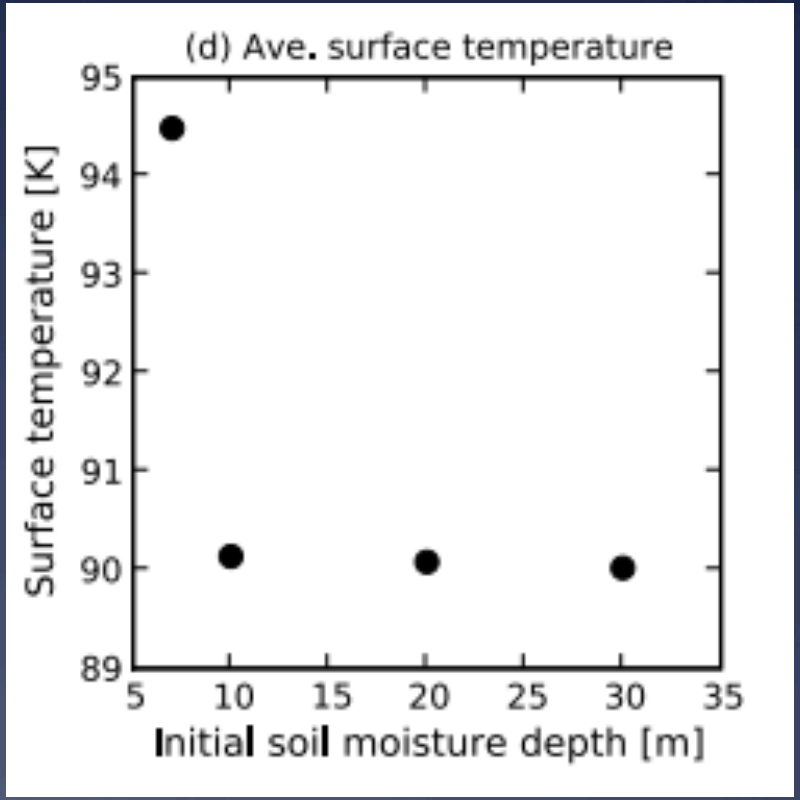
Titan

- Saturn's largest moon
- Thick atmosphere
  - 95.1% N_2
  - 4.9% CH_4
- Hydrocarbon lakes near poles
- Fluvial erosion features across the surface
  - Methane rain
- "Wet" versus "dry" climate



Motivation

- *Mitchell* [2008] showed a possibility of multiple climate equilibria following abrupt climate change on Titan
- I will further explore the effect that various levels of methane concentrations have on the dynamics of the atmosphere using a simpler one-dimensional mode
  - Model Hierarchy: step up for realism, step down for understanding

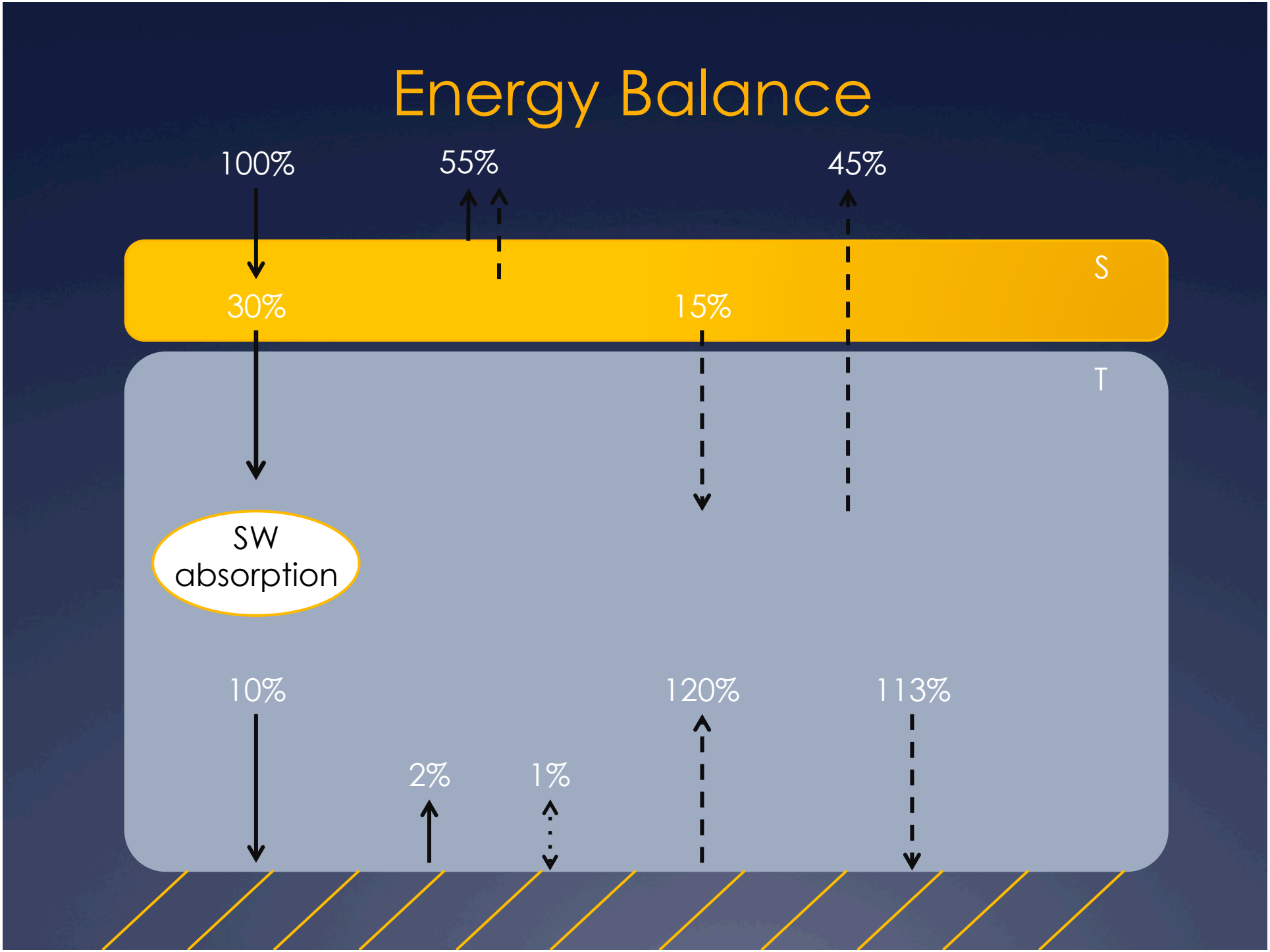


Mitchell [2008]

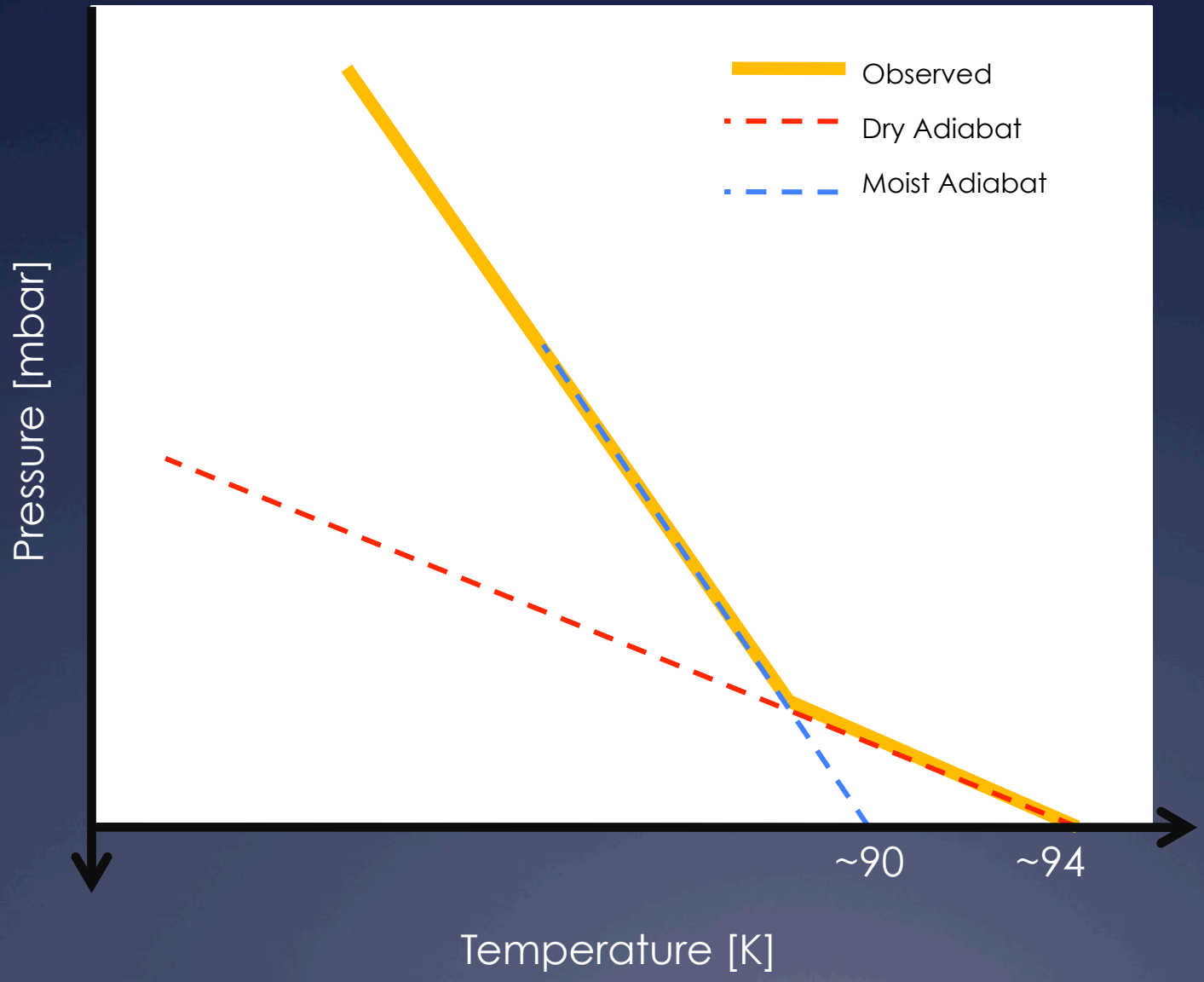
Model

- One-dimensional radiative-convective model
  - Useful for modeling planetary heat budget
  - Lacks horizontal heat transport and latitudinal redistribution of methane
- Highlights the importance of the thermodynamics of methane evaporation and condensation

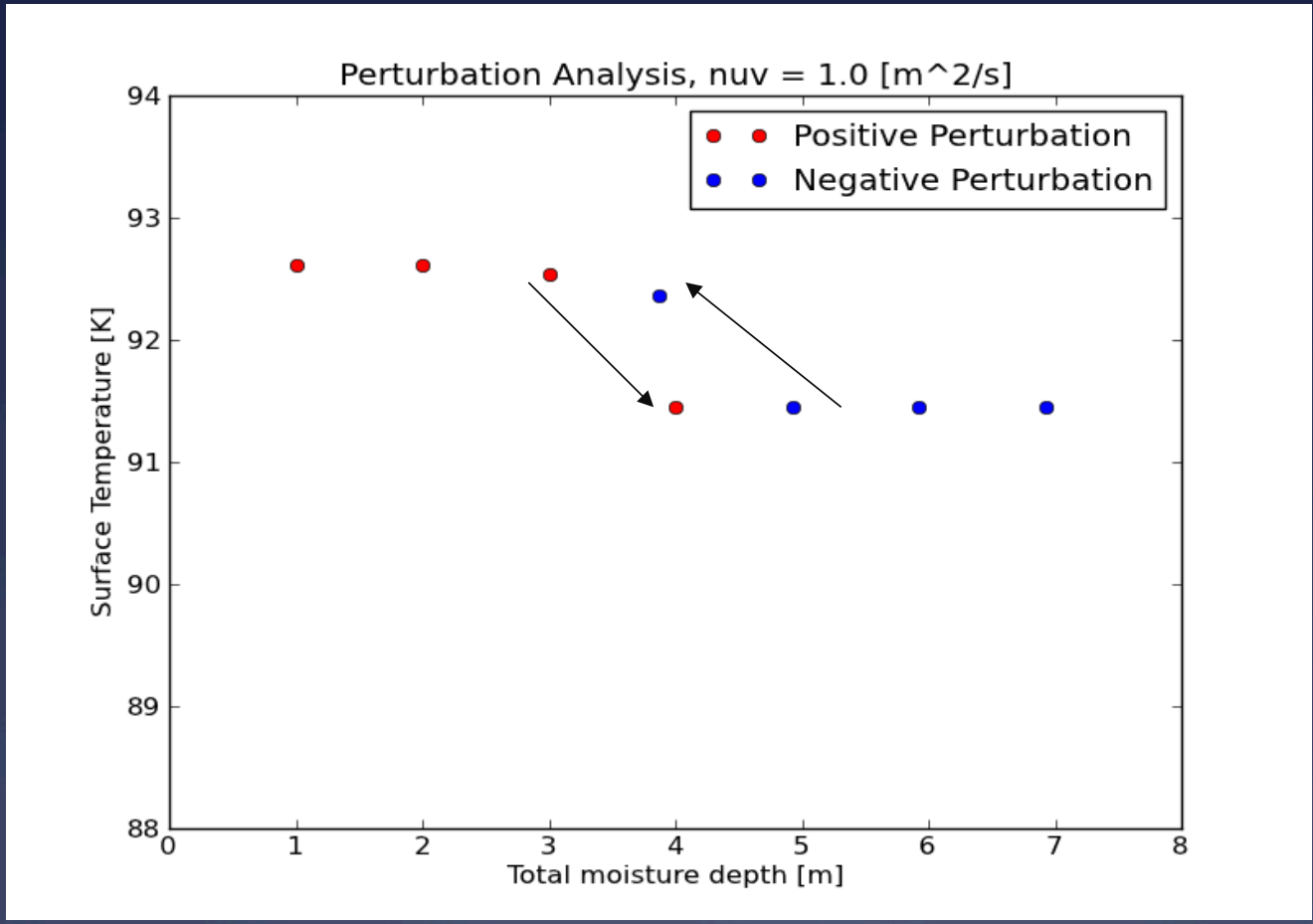
Energy Balance



Dry Convection vs. Moist Convection

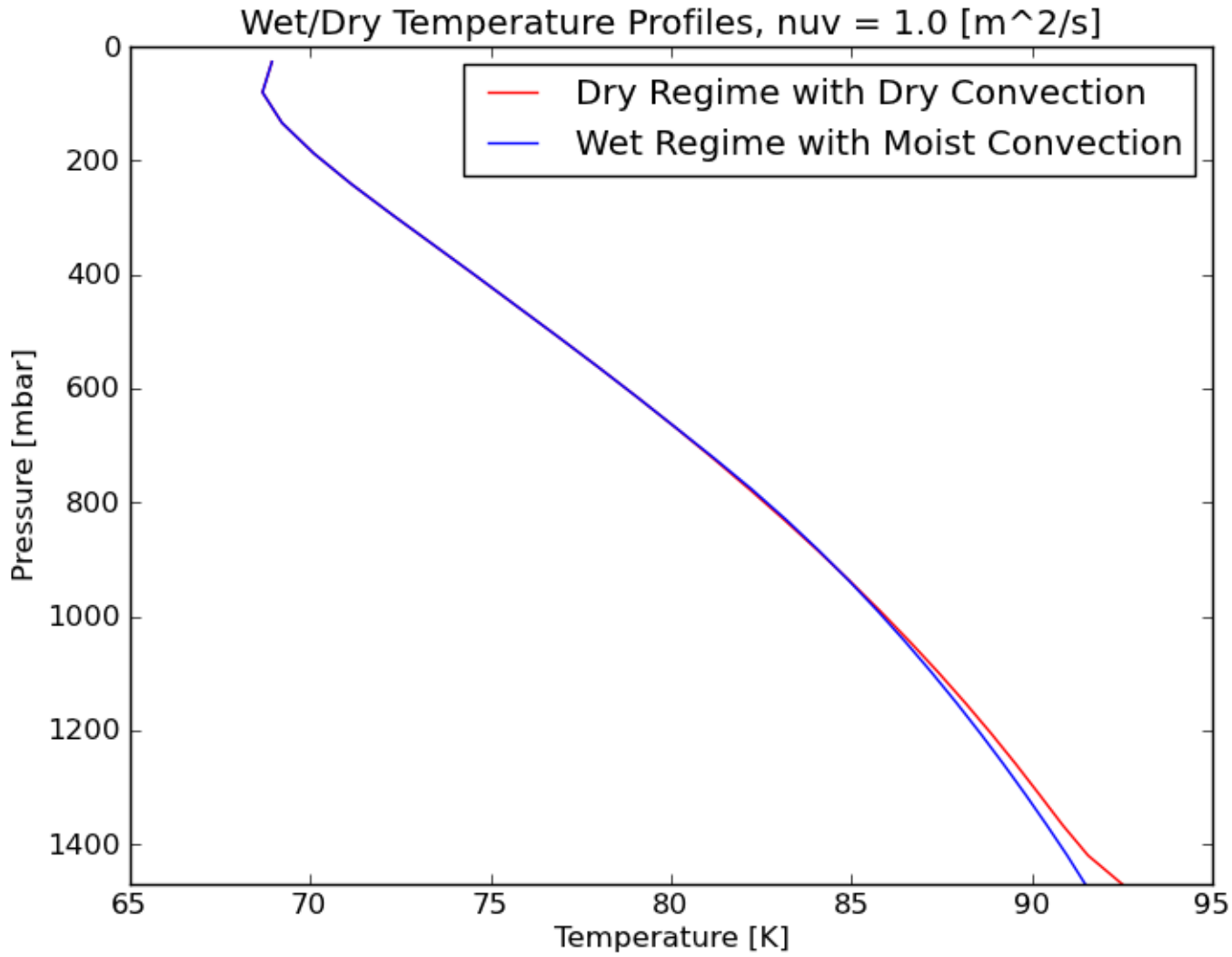


Abrupt Climate Transition



Addition/Removal of surface methane produces a transition in surface equilibrium temperature

Wet and Dry Temperature Profiles



Ts (dry) ~ 93 K

Ts (wet) ~ 91 K

Future goals

- Many parameters to be looked at in more detail
  - Diffusion
  - Boundary Layer
  - Huygens fluxes
    - *McKay et al.* 1991 in good agreement with Huygen's landing site
- Increasing the speed of the model
  - Each run takes ~7 hours
- Build simplified two-dimensional model
  - Allow for horizontal heat transport